International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 4, Issue 5, May – 2020, Pages: 66-71

Alkaline Activation and Selective Characterizations of ***Musa Sapentium*** Peels Biomass Organic Nano-fertilizer.

Olabimtan Olabode. H*[1], Amupitan Martins .A[2], Kaigama Williams.N[3] & Benjamin Abu.E[4]

[1]National Research Institute for Chemical Technology, Department of Industrial and Environmental Pollution Zaria Kaduna State, Nigeria.
[2]Nigeria College of Aviation Technology, Aircraft Maintenance Engineering School Zaria Kaduna State, Nigeria.
[3]Ahmadu Bello University,Faculty of Physical Sciences, Department of Chemistry Zaria,Kaduna State,Nigeria.
[4]University of Jos,Faculty of Natural Sciences, Department of Chemistry Jos Plateau State, Nigeria.
Corresponding author's email* ;Olabode4angel@gmail.com

***Abstract**:Banana peels of Musa sapentium species contains important phytonutrients that are renewable and can be nanotechnologically modified into useful, cheap and resoucefull bio fertilizers. The natural peels were characterized for Proximate and anti-nutritional analysis prior to Physico-chemical characteristics of the banana peel alkaline activated nano fertilizer and image J analysis of SEM result of the alkaline (sodium hydroxide)activated banana peel nano particles. The fertilizer at the nano scale was estimated to be 1660.20± 823.35nm^2 in average area and 2739nm as the range between the nano irregular particles.The synthesized nanofertilizers was initiated with 0.5kg of Musa sapentium peels with 1000ml distilled water and alkaline modification with 10g Sodium hydroxide for 30 miuntes at 105^{o}C being stabilized with urea and dispered with citric acid both at the strength of 5% and pH of 5. Banana peels generally should be an excellent and cheap sources of plant macro (NPK),micro and elemental nutrients as compared with the standards from International Center for Soil Fertility and Agricultural Development Alabama, USA.*

Keywords: Musa sapentium peels, nanofertilizer, physico-chemicals and phyto-nutrients, proximate ,alkaline activation.

1.0 INTRODUCTION

Nanotechnology is the virtuous pragmatic approach requiring the use of equipment and materials capable of molecularly influencing the physicochemical characteristics of the substance [1]. In other words, it involves the manipulation of matter at the size of the nanoscale by which upon the application of such prominent products in the field of agriculture not only increases the production but also provides safe food for consumption. The agriculturist's ultimate objective is generally to establish drought-resistant and pest-resistant crops that also enhance output [2]. In such a scenario, the nanotechnology application has gained broad attention to human health issues, safe lifestyles, resilience, and susceptibility. Nanotechnologies have the potential of developing the farming and food industries with unique nanotools to monitor rapid diagnosis of disease, facilitating plant capacity to obtain nutrients amongst others.The applications of nano-fertilizers have gained some devotions for soil scientists and environmental activists because of the potential to raise yield, reduce pollution, and improve soil quality and their expectations for favorable micro-organism environment[1]. As traditional fertilizers, which hardly surpass 30–35%, 18–20%, and 35–40% respectively for N, P, and K, nano-fertilizers play a vital role in improving productivity in the broad range of crops under nutrient efficiency [1]. Nano fertilizers are reported to produce nutrients for more than 30 days gradually and consistently, which can help increase nutrient requirements without any negative association [3]. Because nano-fertilizers are engineered to maximize gradually over a prolonged period, the deficit of nutrients concerning environmental security is reduced significantly [4]. Due to soil fertilization over some periods, crop yields are continuously decreased owing to soil nutrient deficit and organic matter deficiency [5]. Some occurrences of eutrophication and leaching have been documented due to the massive use of fertilizers in the form of nitrogen and phosphorus [6]. According to the Royal Society, "Nanotechnologies are now the design, characterization, synthesis, and application of nanometer-scaled structures, systems by controlling morphology and size"[7].Nanotechnology is currently moving away from a theoretical basis into operational settings [10]. For example, the production of slow-release fertilizers, pesticides, and herbicides, centered on nanotechnology, had become crucially important in encouraging environmentally sustainable farming development [8]. In reality, nanotechnology has established the viability of incorporating nanostructures or nanoparticle resources as fertilizer carriers or controlled-release vectors for the fabrication of smart fertilizer as new facilities to improve the efficiency of nutrient consumption and reduce environmental protection costs [9]. They are formulated either by enhancing nutrients individually or in combination with nano-dimension onto the adsorbents. Both physiological and biochemical approaches are often used to develop nanomaterials and the required nutrients are charged as they are for cationic nutrients (NH_4^+, K^+, Ca^{2+}, Mg^{2+}) and anionic nutrients (NO_3^-, PO_4^{2-}, SO_4^{2-}) after substrate modification [10].Formulation of fertilizers in nanomaterials is one of those modern techniques that are made in three stages (a) the nutrient can be encapsulated in nano-porous materials, (b) coated with a thin polymer film, or (c) distributed as nano-scale particles or emulsions [9].

Banana peels as organic waste have attracted considerable attention because of their extract, which is rich in natural phenolic antioxidants such as vitamins, flavonoids, essential amino acids, growth promoters, and potassium elements needed for plant growth[11][12]. Banana peel had been used to stimulate significant impacts in plants on various biological aspects [13]. One of these biological characteristics is the expanding germination level of seed due to its excellent potassium content, amino acids (i.e., L-tryptophan), and growth regulators, as stated in former investigations[11]. Here, the possibility of converting and activating (alkaline) waste banana peels of musa sapentium species into nano active and cheap organic fertilizer using urea and citric acid as carrier and dispersant respectively.

2.0 MATERIALS AND METHODS

Banana peels (*Musa sapentium*), distilled water, ph meter, analar grade potassium hydroxide, citric acid and urea.

2.1 Extraction preparation of Nano fertilizer from banana peels

Tap water washed 0.5 kg of banana peels (Musa sapentium) to remove the dust and any particulates adhered to the surface. The washed peels were shredded to tiny pieces and then blended with 1000ml distilled water using a mechanical high-speed blender. The produced gelatinous slurry was mixed with the calculated amount of 10g sodium hydroxide and stirred for a minute to generate a homogenous mixture.The alkaline mixed slurry was boiled for 30 min with stirring. After boiling the slurry was kept ready for further processing to cool at room temperature. The cold slurry was subjected to filtration by vacuum to obtain transparent brown filtrate and dense dark brown sludge. The transparent filtrate was thus heated to approximately 70°C, with continuous stirring at 300 rpm. The urea and citric acid (5%) were then applied to dropwise until pH 5. The sludge obtained was allow to dry at 105°C, and was pulverized to a fine powder [11].

2.2 Proximate and anti-nutritional analysis of the activated Musa sapentium peels

[14]

2.3 Physico-chemical characteristics of the banana peel activated nano fertilizer

pH was by JIS Z 8002 methods[15],moisture content by loss on drying method [16],ash content by Ignition residue method [17],electrical conductivity was according to JIS K 0130 method[18],oil content [19],total nitrogen by kjeldahl method [20], total phosphoric acid by quinolone gravimetric analysis [21],total potassium with sodium tetraphenylborate gravimetric analysis [22],alkalinity by ethylenediamine tetra acetate method [21], water-soluble boron by azomethine-h method [25], organic carbon by dichromate oxidation method [26],total sulfur content by potassium permanganate analysis [27], and soluble manganese, water-soluble iron, total zinc, total copper, by Flame AAS [24].

2.4 Nanoparticle analysis

Alkaline activated banana peel nano particles analysis with image J [28].

3.0 RESULTS AND DISCUSSION

Table 1. Proximate and anti-nutritional analysis of natural banana peels

Proximate and anti-nutritional analysis	Value(%)
Moisture content	45.80
Protein	4.70
Crude Lipid	2.30
Crude Fiber	20.10
Ash	8.50
Organic matter	51.00
Carbohydrate	54.00
Phytate	0.34
Saponins	22.50

Table 2. Physico-chemical characteristics of the banana peel alkaline activated nano fertilizer

Parameter	Value
pH	7.30
Moisture Content (%)	5.20
Ash content(%)	7.53
Electrical conductivity(us/cm)	1052
Oil content(%)	2.20
Total nitrogen(%)	0.89
Total phosphoric acid (%)	0.52
Total potassium (%)	1.00
Total zinc (%)	0.004
Total copper (%)	0.002
Alkalinity (%)	
Soluble manganese (%)	0.001
Water-soluble iron (%)	0.080
Water-soluble boron (%)	0.005
Organic carbon (%)	36.50
Total sulfur (%)	0.070

Table 3. Proposed Fertilizer Regulations, 2003 Under Proposed Fertilizer Act, 2003 Prepared by IFDC – An International Center for Soil Fertility and Agricultural Development Alabama, USA.

International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 4, Issue 5, May – 2020, Pages: 66-71

Element	*Form*	*%*
Nitrogen	N	1.00
Phosphate	P_2O_5	1.00
Potassium	K_2O	1.00
Calcium	Ca	1.00
Magnesium	Mg	0.50
Sulphur	S	1.00
Boron	B	0.02
Chlorine	Cl	0.01
Cobalt	Co	0.0005
Copper	Cu	0.05
Iron	Fe	0.10
Manganese	Mn	0.05
Molybdenum	Mo	0.0005
Sodium	Na	0.10
Zinc	Zn	0.05
Heavy metals (ppm/kg of bio solids)		
Arsenic	Ar	13
Cadmium	Cd	10
Chromium	Cr	Nil
Lead	Pb	61
Mercury	Hg	1
Nickel	Ni	250
Selenium	Se	26
Electrical conductivity(uS/cm)	< 1200	

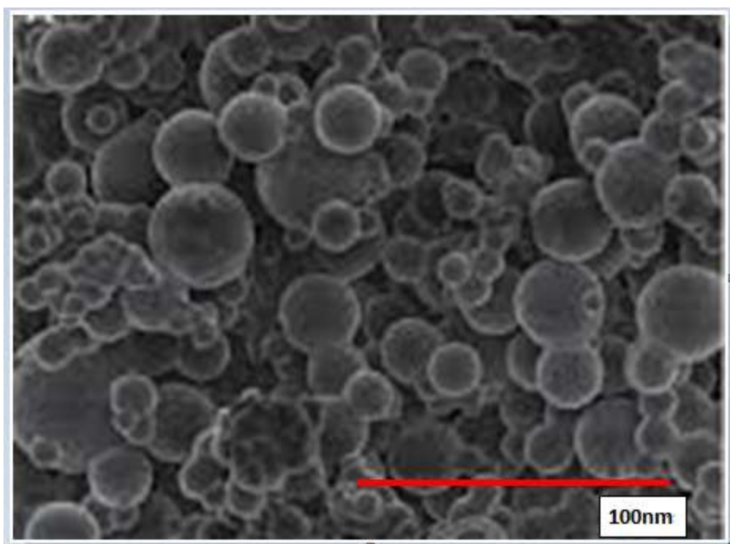

Figure 1. SEM of the alkaline activated banana peels (musa sapentium) nano fertilizer

Table 4. Descriptive statistics of the SEM banana peel nanofertilizer as analyzed with image J

Image J descriptive statistic	
Mean	$(1660.20\pm 823.35)nm^2$
Median	1422nm
Range	2739nm
Maximum	3427nm
Minimum	688nm

Table 1 declares the proximate and antinutritional compositions of this species of banana(musa sapentium) adopted for this project.The level of moisture ,protein, organic matter and carbohydrate already position the natural peels as a good source of bio fertilizer.The physico-chemical characteristics of the obtained alkaline modified (pH=7.30) banana peel was disclosed in table 2.Similarly, the properties of the synthesized banana peel alkaline nanofertilizer as shown in table 3 were all under the recommended limits and requirements.Image J nanoparticles size analysis was deployed in estimating the average area and range of these nanoparticles statistically (table 4) as the components of the nano fertilizer from the image generated by SEM at 100nm magnification scale (figure 1). The mean average size in terms of area was estimated to be $1660.20\pm$ $823.35nm^2$ with the range of 2,739nm amongst the irregular nano particles morphologies.

4.0 CONCLUSION

Proximate analysis of the natural banana peel biomass are direct and fulfilling indications as a biofertilizer with modification nanotechnologically. Substituting the conventional synthetic media with cheaper alternative like agricultural substrates, will save the production cost. The results of nutritional analysis suggest that banana waste for growing microorganisms may perhaps be the cheapest and valued bio-resource. This technology will guide to green environment as the extract from nanoform will add some positive impacts as growth promoter. Nano based bio stimulant fertilizer through banana peels under alkaline conditions is attributed to the presence of both urea which is used as a carrier for these mineral citrate in the nanoform and citric acid which is reacted with the minerals, forming mineral citrates.

5.0 COMPETING INTERESTS

The authors declare that they have no competing interests.

6.0 REFERENCE

1. Kanjur Wangdi (2019). PRODUCTION OF NANOFERTILIZER- A MINI REVIEW. International Journal of Engineering Applied Sciences and Technology, 2019 Vol. 4, Issue 3, ISSN No. 2455-2143, Pages 1-4 Published Online July 2019 in IJEAST (http://www.ijeast.com).
2. Prasad, R.et al (2017). Nanotechnology in Sustainable Agriculture: Recent Developments, Challenges, and Perspectives. Frontiers in Microbiology, 8. doi:10.3389/fmicb.2017.01014
3. Subramanian, K. S. et al(2015). Nano-fertilizers for Balanced Crop Nutrition. Nanotechnologies in Food and Agriculture, 69–80. doi:10.1007/978-3-319-14024-7_3
4. Rai, M.et al (2015). Nanotechnologies in Food and Agriculture. doi:10.1007/978-3-319-14024-7.
5. Ngatia, L.et al (2019). Nitrogen and Phosphorus Eutrophication in Marine Ecosystems.
6. Royalsociety.org. (2019). https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2004/9693.pdf.
7. Chinnamuthu C R and P Murugesa Boopathi (2008). Nanotechnology and Agroecosystem https://www.researchgate.net/publication/266892239_Nanotechnology_and_Agroecosystem.
8. Guru Tulasi et al (2014) Role of Nano fertilizers in agricultural farming https://www.researchgate.net/publication/324977942_Role_of_Nano_fertilizers_in_agricultural_farming.
9. Subramanian, K. S.et al (2015). Nano-fertilizers for Balanced Crop Nutrition. Nanotechnologies in Food and Agriculture, 69–80. doi:10.1007/978-3-319-14024-7_3 .
10. Hussein, H.S. et al.(2019) Preparation of nano-fertilizer blend from banana peels. Bull Natl Res Cent **43,** 26 . https://doi.org/10.1186/s42269-019-0058-1.
11. Hussein et al.(2019). Preparation of nano-fertilizer blend from banana peels Bulletin of the National Research Centre. 43:26 https://doi.org/10.1186/s42269-019-0058-1
12. Lee, E.-H.et al (2010). Development of banana peel jelly and its antioxidant and textural properties. Food Science and Biotechnology, 19(2), 449–455. doi:10.1007/s10068-010-0063-5
13. Paiko, Y. B et al (2015). Proximate, mineral and anti-nutritional composition of the outer peel and seed coat

of Chrysophyllum albidum (African Star Apple) obtained from Minna, Niger State, Nigeria. Jewel Journal of Scientific Research (JJSR) 3(1): 1- 6, 2015 ©Federal University, Kashere-Nigeria (ISSN: 2384 - 6267) www.fukashere.edu.ng

14. JIS Z 8802:20119 (2011) - Methods for determination of pH of aqueous solutions (Foreign Standard). https://webstore.ansi.org/Standards/JIS/JIS88022011.

15. Kb.psu.ac.th. (2012). http://kb.psu.ac.th/psukb/bitstream/2553/1573/2/271250_app.pdf.

16. Post, G. (2017). Estimation Of Ash Content In Food - Discover Food Tech. Discover Food Tech. https://discoverfoodtech.com/estimation-of-ash-content-in-food/.

17. JIS K 0130:2008 (2008).General rules for electrical conductivity measuring method (FOREIGN STANDARD). https://webstore.ansi.org/Standards/JIS/JIS01302008.

18. Japan Oil Chemist 'Society: Standard Method for the Analysis of Fats, Oils and Related Materials (2003), 1.5 Oil content p. 1 - 2, Incorporated Foundation Japan Oil Chemist 'Society, Tokyo.

19. Kimie KATO et al (2012) Verification of Performance Characteristics of Testing Method for Total Nitrogen Content in Fertilizer by Kjeldahl method, Research Report of Fertilizer, Vol. 5, p. 156 – 166.

20. Stockreiter, N. (2020). Inorganic feed phosphate test methods. https://www.feedphosphates.org/index.php/guides/11-guides/19-inorganic-feed-phosphate-test-methods.

21. Keiji YAGI, et al(2012).Verification of Performance Characteristics of Testing Methods for Potassium Content in Fertilizer by Gravimetric Sodium Tetraphenylborate analysis, Research Report of Fertilizer Vol. 5, p. 201 – 211.

22. Integrated Publishing, I. (2020). The Hardness Test. Constructionmanuals.tpub.com. http://constructionmanuals.tpub.com/14265/css/The-Hardness-Test-273.htm.

23. Akira SHIMIZU: Verification of Performance Characteristics of Testing Methods for Boron Content by Azomethine H Absorption Photometry, Research Report of Fertilizer Vol. 6, p. 174 –182 (2013)

24. Yuji SHIRAI, et al (2010). Validation of Determination Method for Organic Form Carbon in Sludge Fertilizer and Compost, Research Report of Fertilizer, Vol.3, p. 117 - 122 .

25. Yasushi SUGIMURA and Shinjiro IZUKA (2010). Method validation of Redox Titration for Determination of Sulfur content (as sulfur trioxide) in Fertilizers of Ferrous sulfate and its mixture materials, Research Report of Fertilizer, Vol.3, 2010. (25 - 29)

26. Particle Analysis. ImageJ. (2020). https://imagej.net/Particle_Analysis.